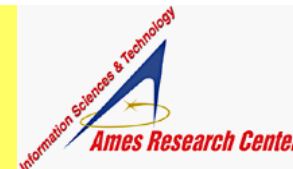




ScienceDesk Project Overview



ScienceDesk Team

Rich Keller (PI)
Jim Chen
Kim Hubbard
Dennis Heher
Larry Kiser
Shawn Wolfe

Jon Guice

***Computational Sciences
Division***

NAI Early Microbial Ecosystems Research Group (EMERG)

Dave Des Marais
Brad Bebout
Lee Prufert-Bebout
Tori Hoehler
Scott Miller
Linda Jankhe
Chris Raleigh

***Exobiology
Branch & NAI***

Electron Microscope Team

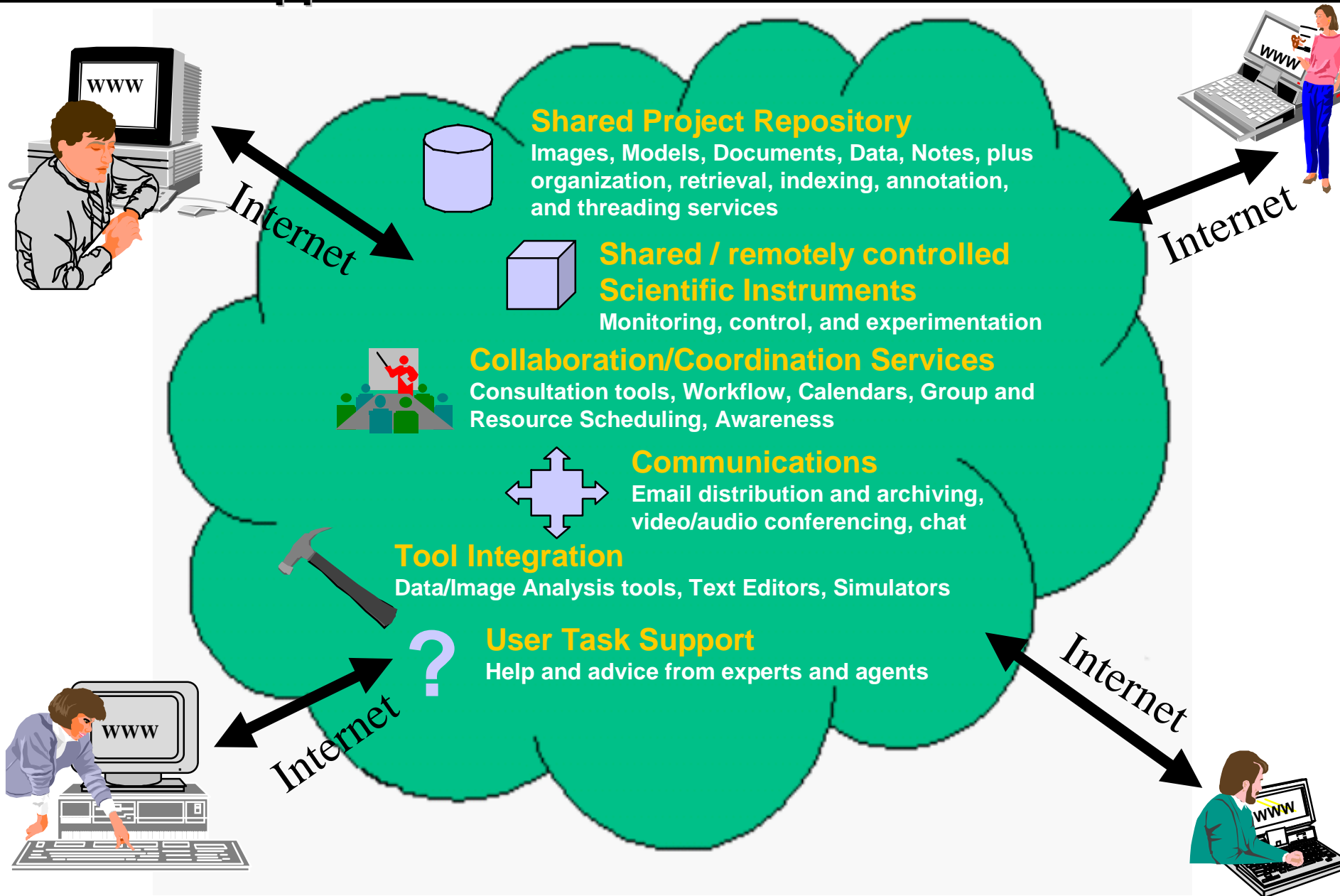
Dave Blake
Lee Bebout
Kathy Kato
Sherry Cady
Lori Crumbliss

***Exobiology
Branch***

NASA Ames Research Center
Funded by: CETDP, NAI, IS

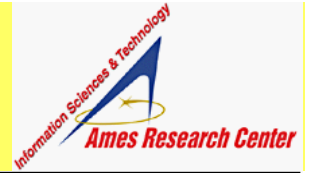


ScienceDesk Charter: Infrastructure support for distributed scientific teams





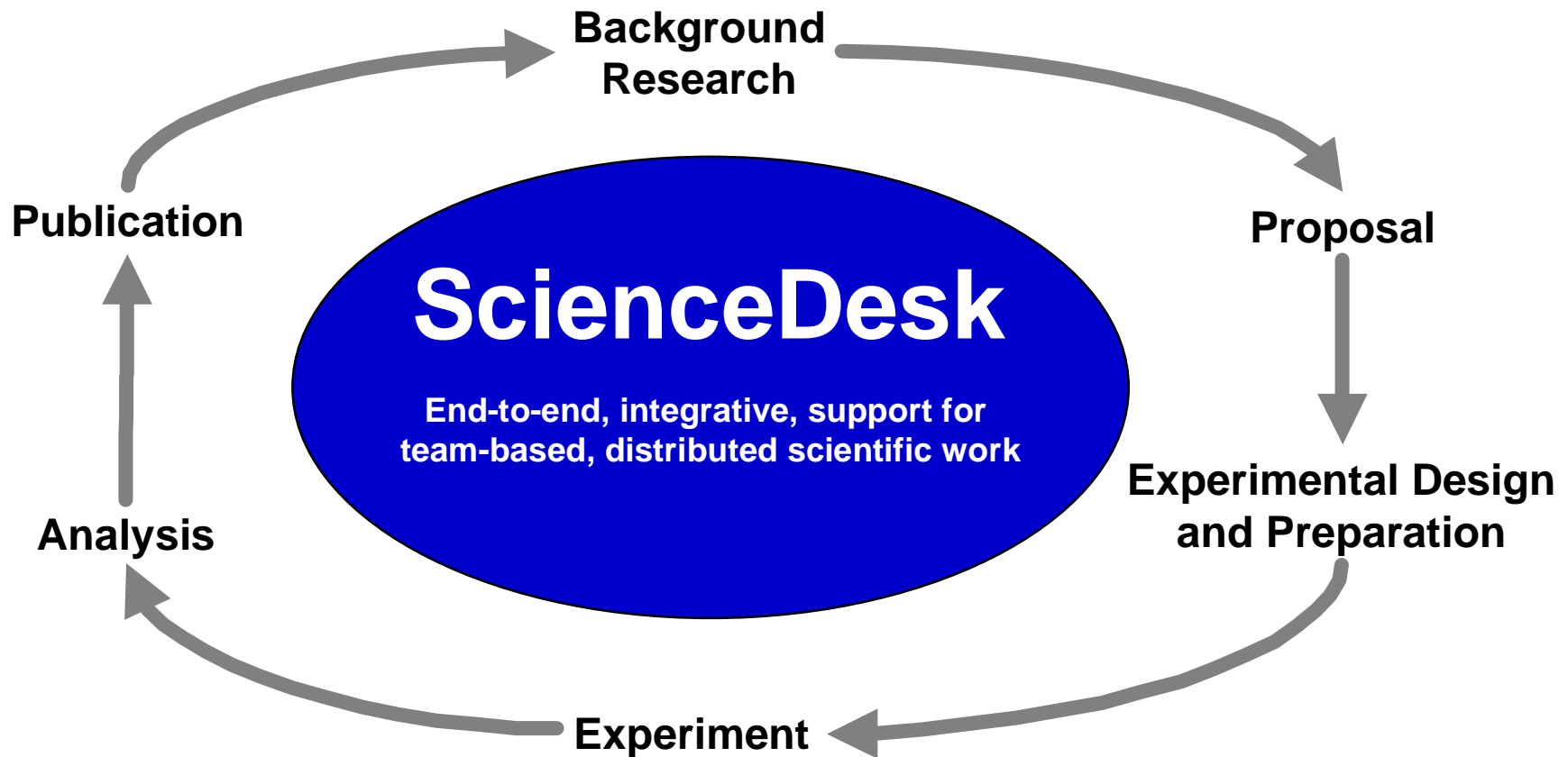
Specific Research Focus



- **Scientific Knowledge Management:** capture, preservation, traceability of scientific knowledge
- **Information Access:** intelligent indexing and visualization
- **Collaboration:** asynchronous and synchronous science teamwork
- **Semi-autonomous Remote Experimentation:** intelligent monitoring and control



Lifecycle Support for Scientific Teams





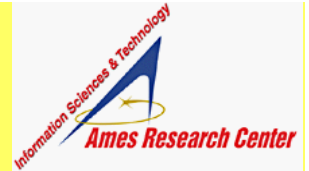
ScienceDesk Motivation



- **Critical nature of scientific work:** essential for success of NASA missions cross-enterprise, yet little infrastructure support
- **Inevitability of distributed work:** conducted in offices, labs, field, spacecraft using multi-person, cross-institutional teams; remote collaboration and information sharing is essential
- **Inadequacy of scientific recordkeeping:**
 - a logistical nightmare with multiple media and formats;
 - difficult and tedious, resulting in inefficiencies,
 - irreproducibility, dissemination failures, and “organizational amnesia”
- **Limited scientific resources:** Valuable, one-of-a-kind resources must be shared electronically:
 - information & data on rare samples (moon rocks, Mars meteorite)
 - expensive instruments (electron microscopes, gas chromatographs)

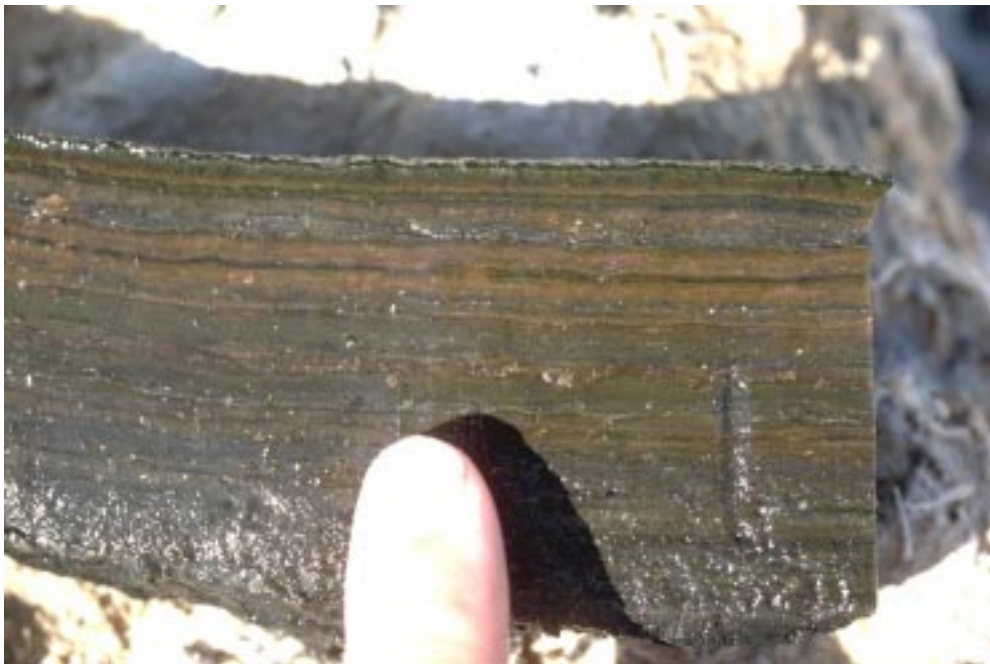


ScienceDesk Testbed: Early Microbial Ecosystems Research



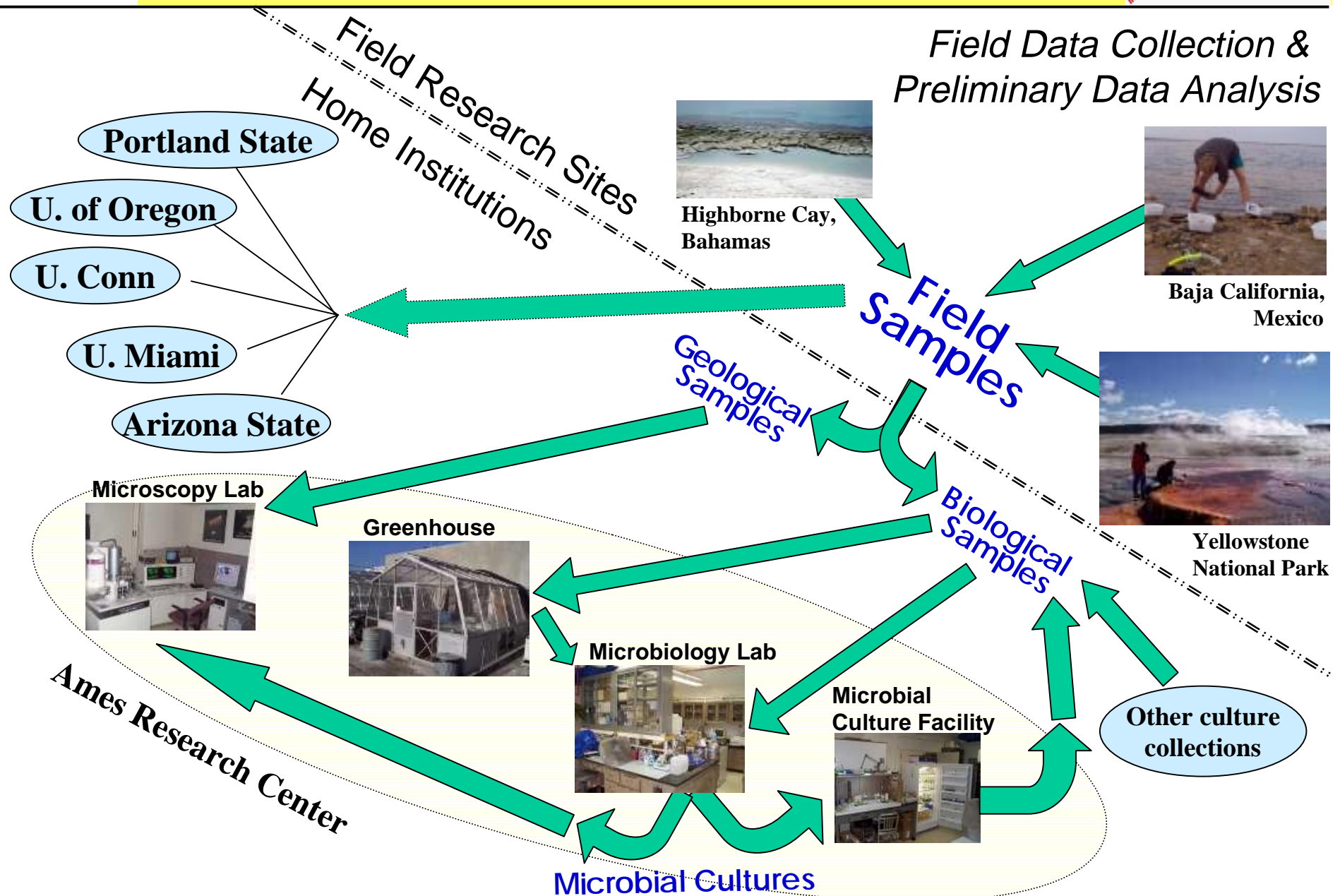
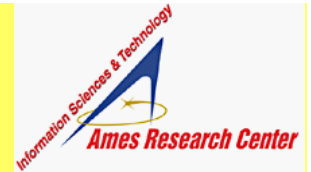
Study of “Microbial Mats”

- Photosynthetic microbial mats are the oldest known ecosystem on Earth
- Can be found in extreme environments (thermal, saline, high carbonate)
- Serve as an early-Earth analog for studying development of life





Early Microbial Ecosystems Group: Distributed Field and Lab Work





Human-Centered Methodology



**Study science
team in operation**

- interview
- observe (lab & field)
- videotape

**Participatory design
& partnership**

Analyze and model

- workflow
- procedures
- communication flow

**Develop new
IT concepts
& tools**

- ScienceOrganizer
- Shared Image Annotator
- O2 Microsensor Controller

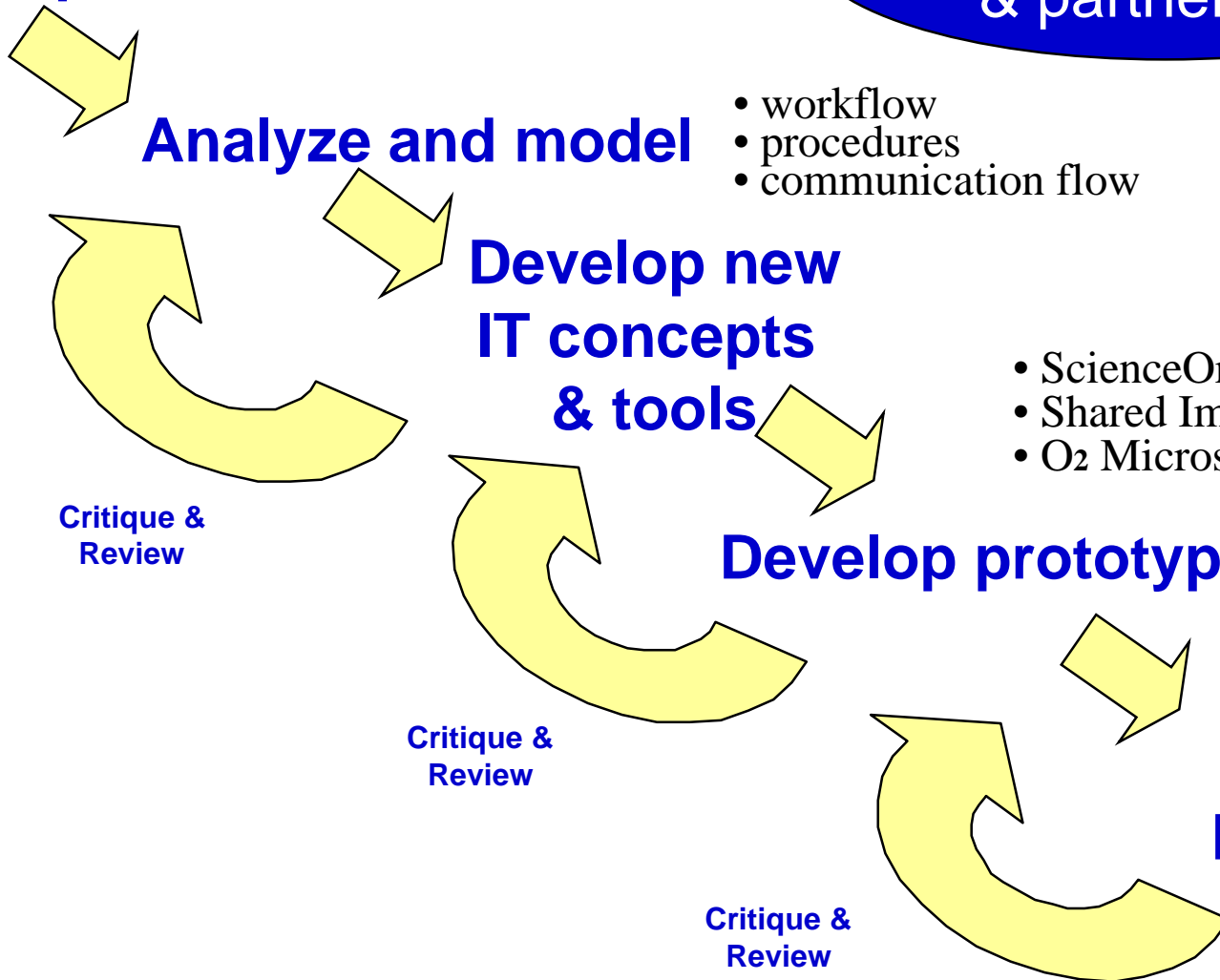
Develop prototype

**Evaluate
prototype**

**Critique &
Review**

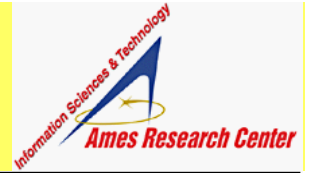
**Critique &
Review**

**Critique &
Review**





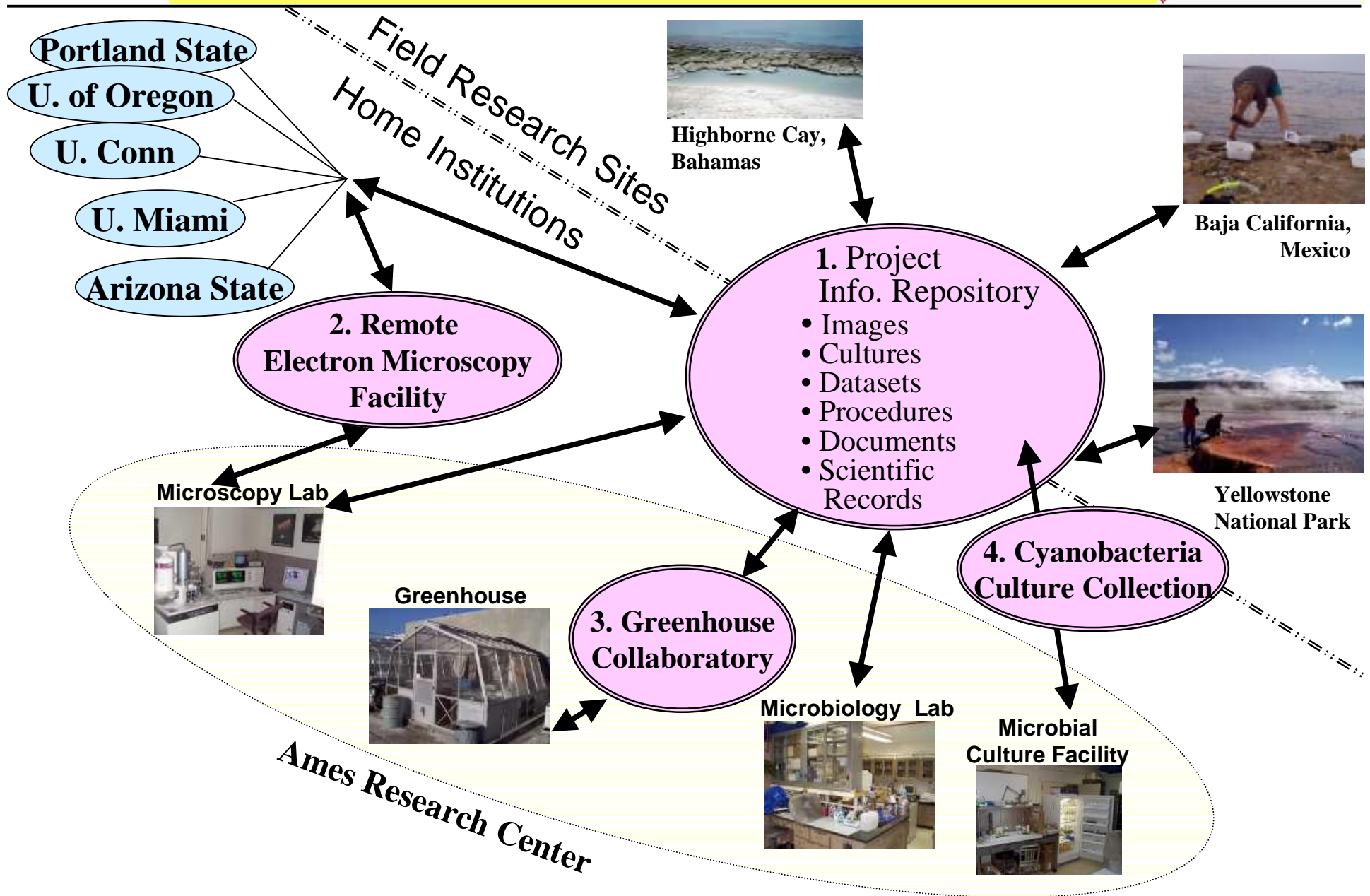
Bottlenecks Observed



- **Information sharing, management**
- **Information tracking**
- **Historical preservation, replication of results**
- **Access to scientific instruments & facilities**
- **Scientific consultations**
- **Remote experimentation**

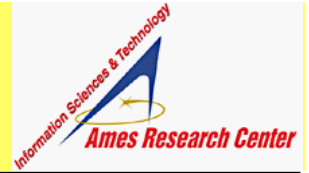


Four ScienceDesk Development Thrust Areas





Thrust 1: Project Information Repository

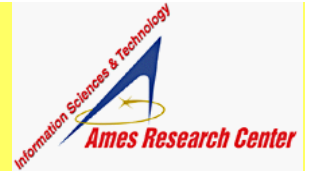


- Create centralized repository for project information:
 - documents
 - datasets
 - images
 - scientific records
 - procedures
- Facilitate linkages between related information
- Establish “Nerve center” for team’s knowledge and data management activities

Tool developed: ***ScienceOrganizer***



Thrust 2: Remote Electron Microscopy Facility

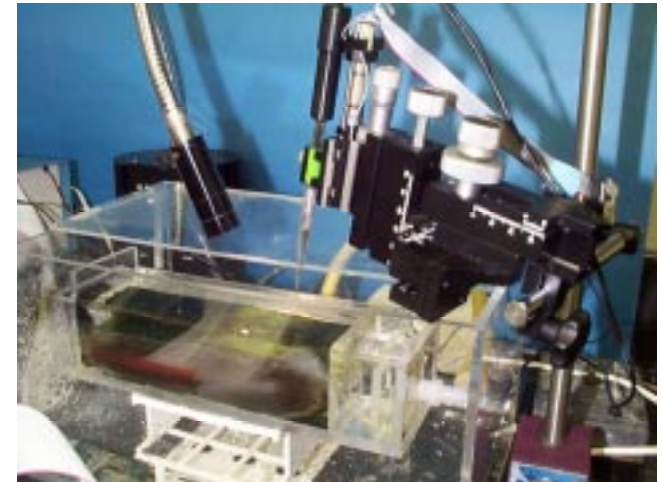
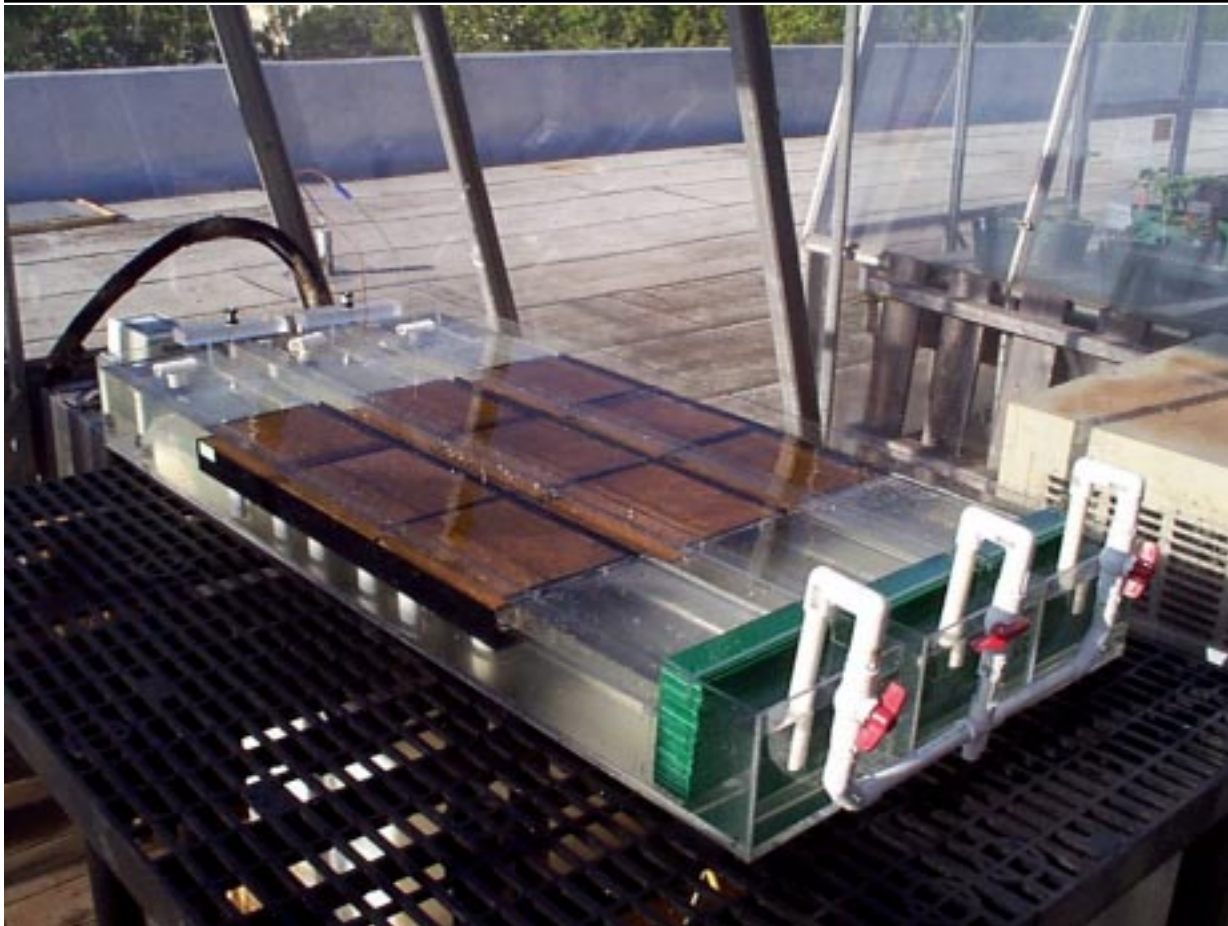


- Remote control of electron microscope
- Enable collaborative image annotation & consultation
- Webcam and Timbuktu for collaboration support
- EM images stored in ScienceOrganizer repository
- Recent collaboration with NREN & NAI

Tool developed: *Shared Image Annotator*



Thrust 3: Greenhouse Collaboratory

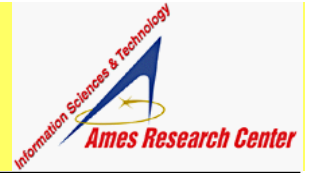


- Synchronous control and monitoring of scientific instruments
- Experiment planning and protocol mgmt
- Intelligent agents
- Integration of acquired data into ScienceOrganizer

Tool developed:
Microsensor Controller
(a.k.a. “Matsticker”)



Thrust 4: Cyanobacteria Culture Collection



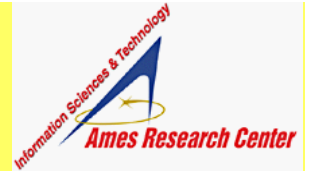
- Specialized repository for microbial cultures
- Electronically “Housed” within ScienceOrganizer
- Linkage between organisms’ metabolic functioning and collection environments
- Searchable based on detailed criteria
- Possible linkage with Univ. of Oregon collection



Capability Developed:
***Ames Exobiology
Culture Collection
(within ScienceOrganizer)***

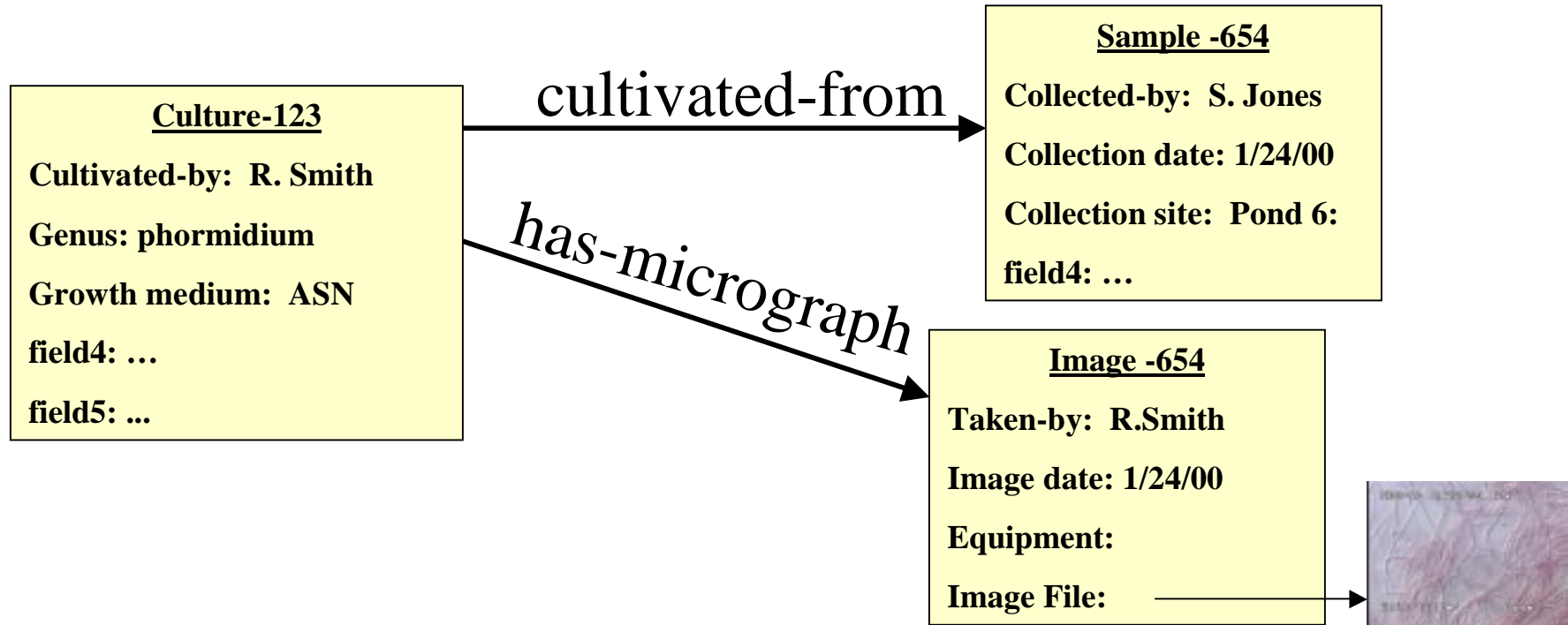


ScienceOrganizer Primer



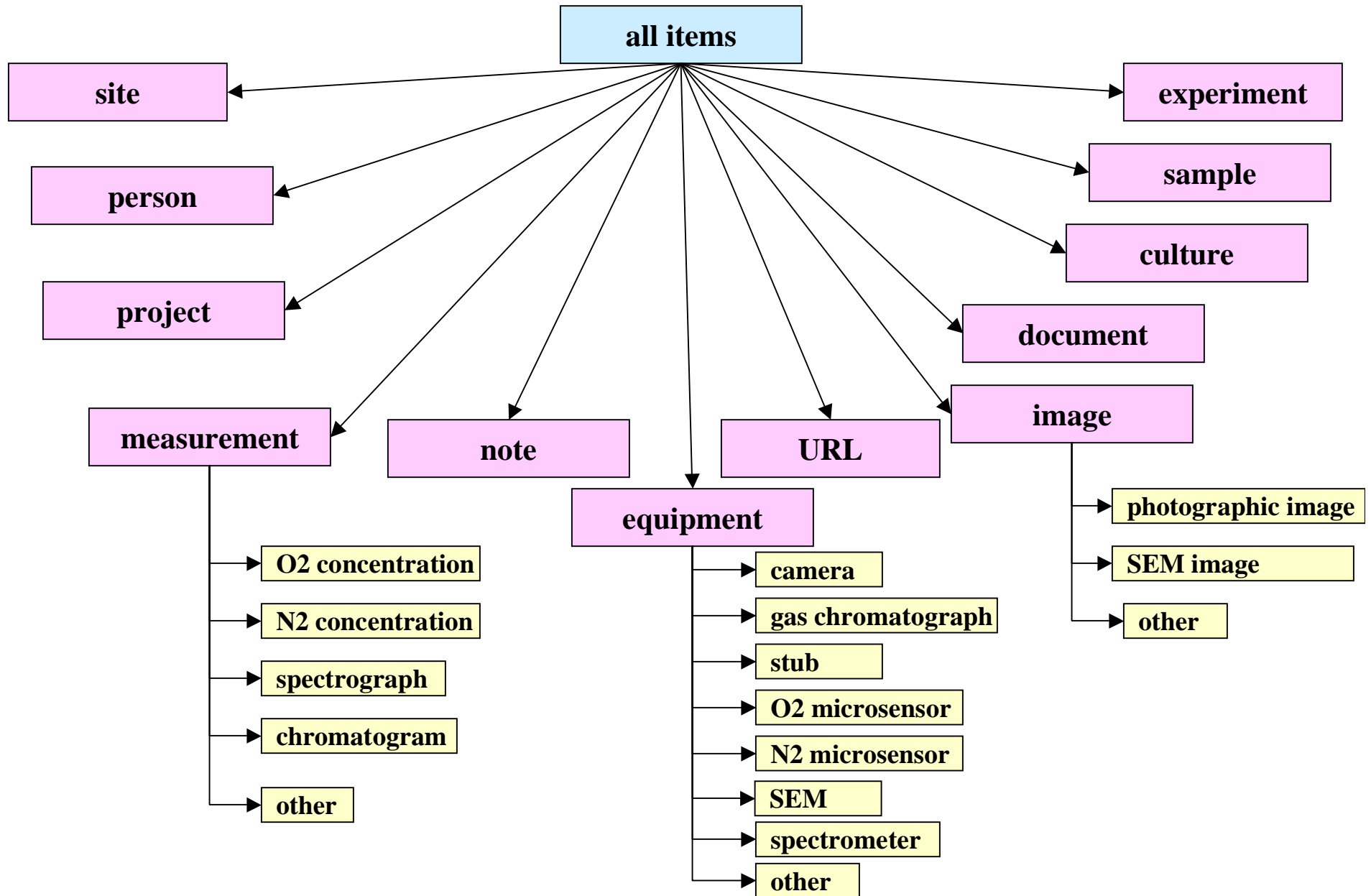
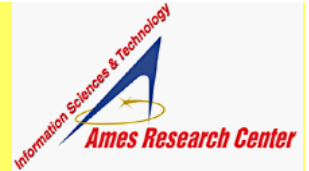
Purpose: Enter, interlink, and subsequently access scientific project information

- Information Items (e.g., scientific records, images, documents, measurements)
 - Contain text or numeric fields
 - Have attached files (e.g., Word, Excel, dataset)
- Links can be created between Items



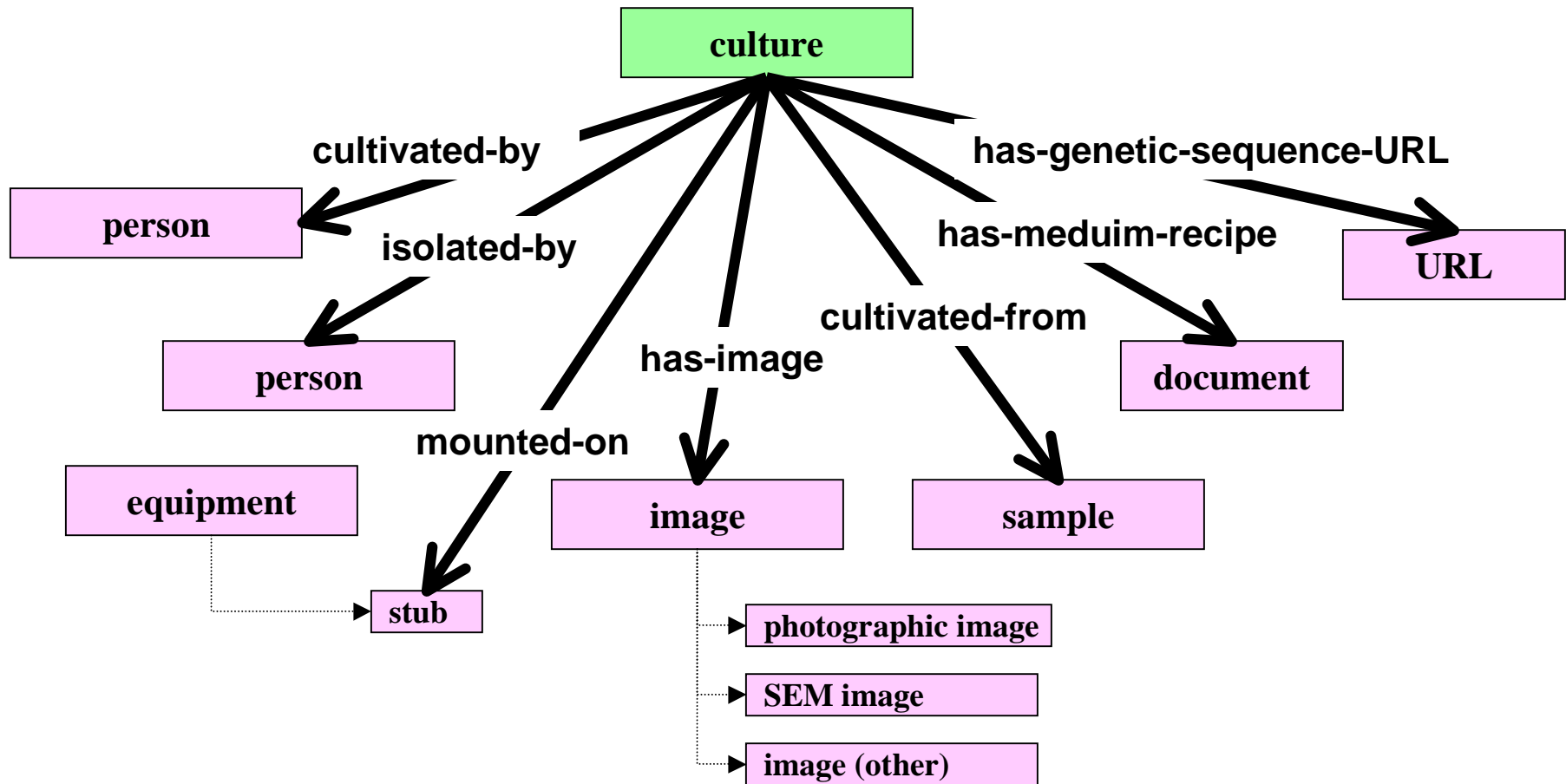


Types of Science Organizer “Information Items”



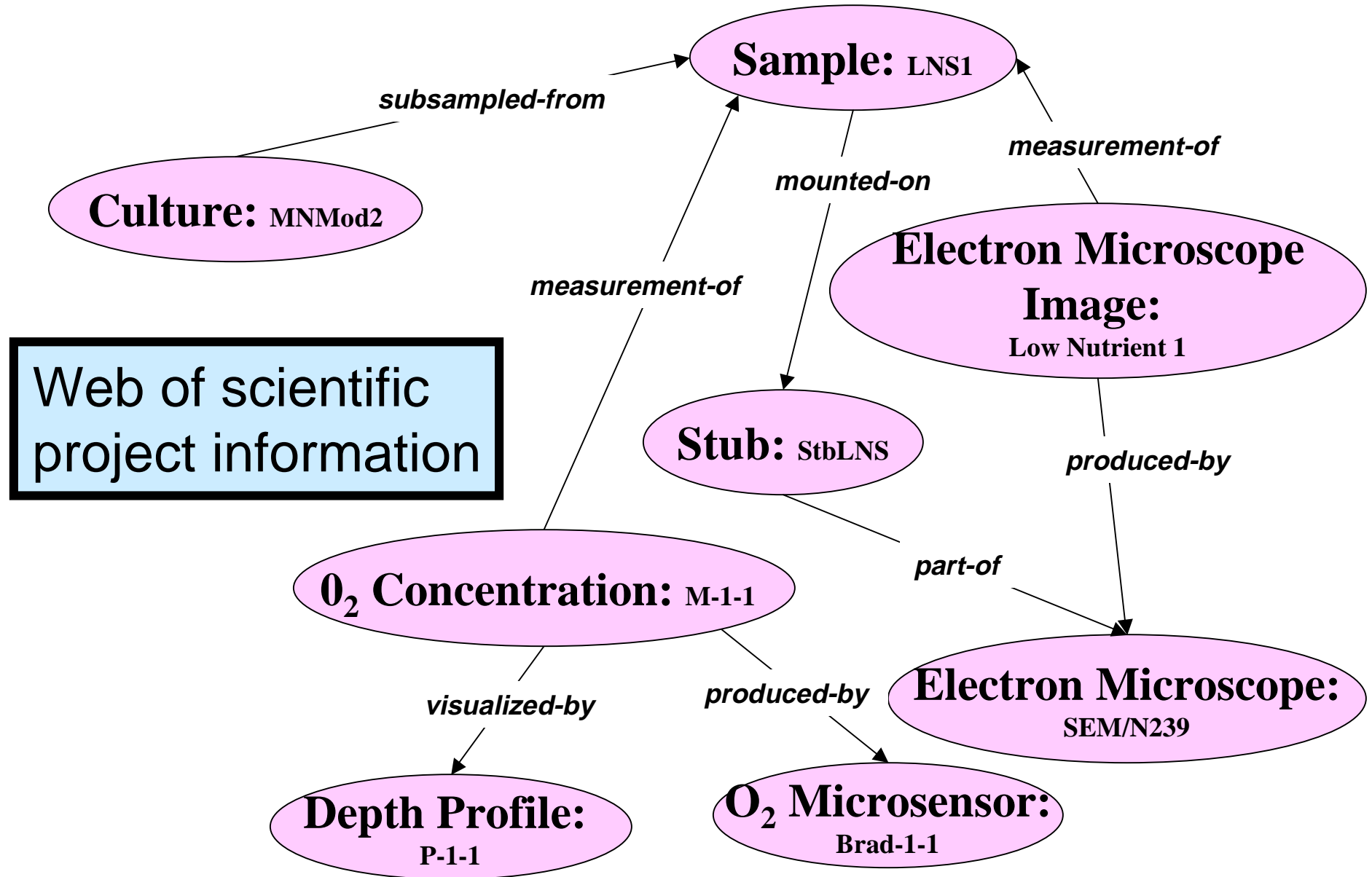
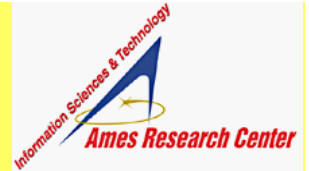


Sanctioned Links between Items





Semantic Relationships among Scientific “Information Items”





ScienceDesk Tools Demonstration

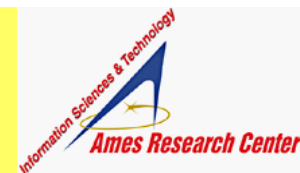


Demonstration!



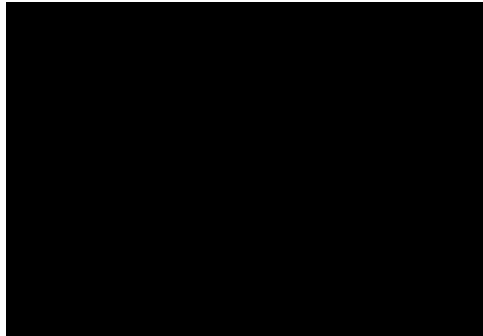
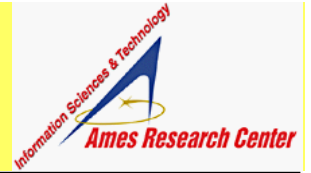
ScienceOrganizer:

A threaded scientific repository



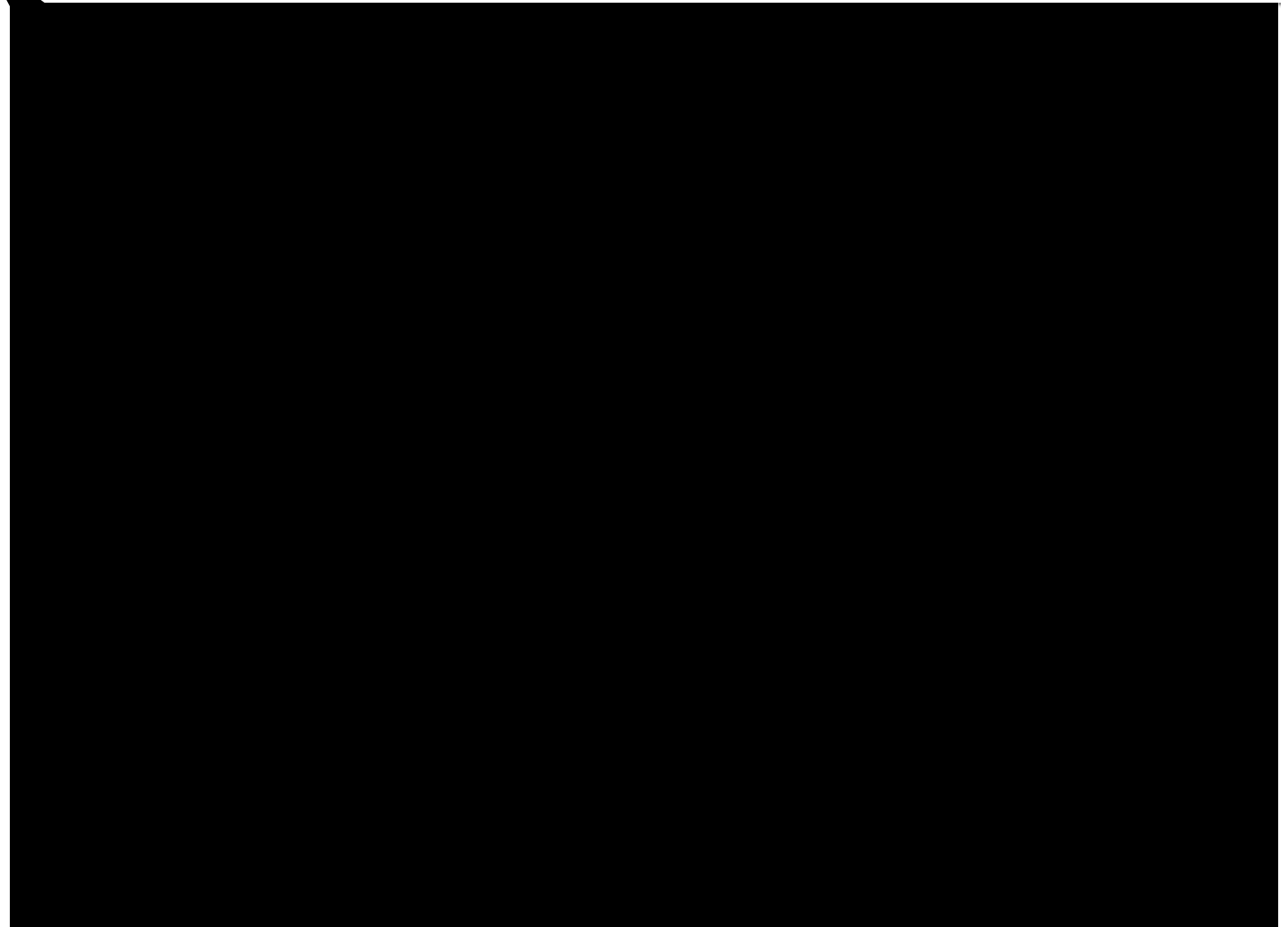


Auxiliary tool: Shared Image Annotator



ScienceOrganizer

Collaborative Whiteboarding & Annotation Tool

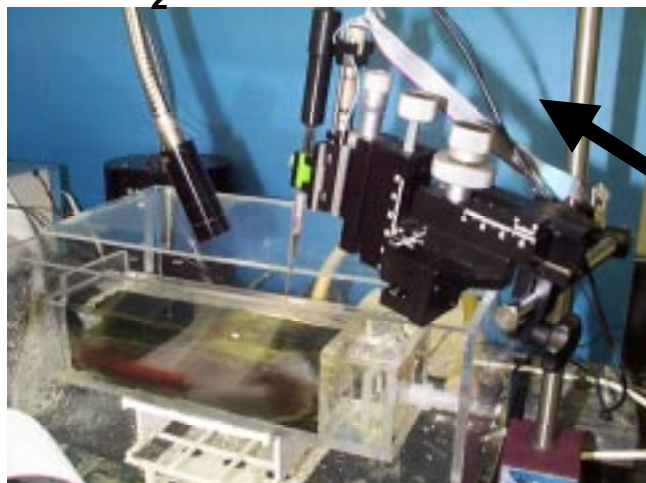




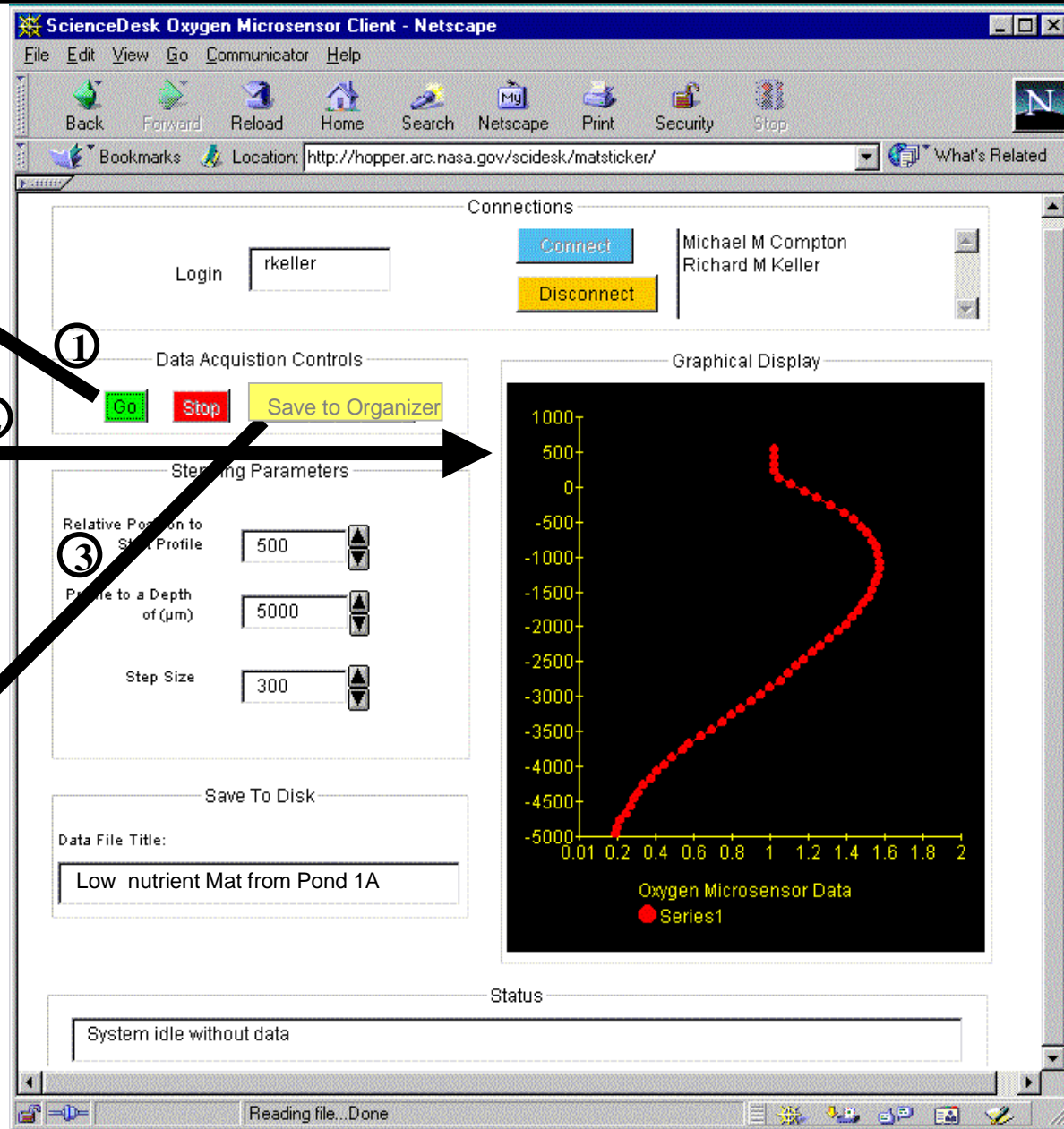
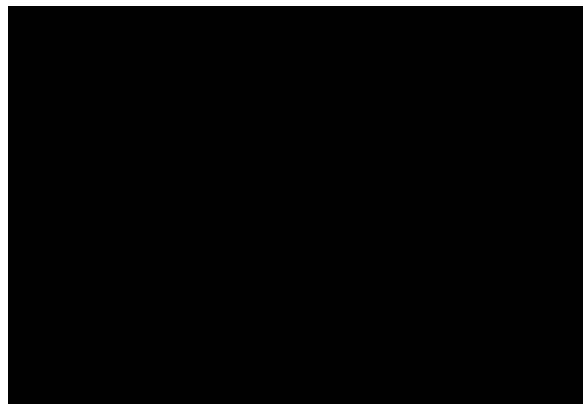
Remote Experimentation: Oxygen Microsensor Remote Controller



O₂ Microsensor

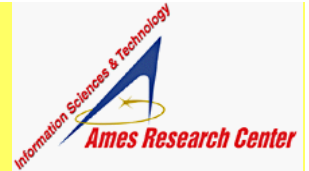


ScienceOrganizer





Project Status



FY'99 Achievements:

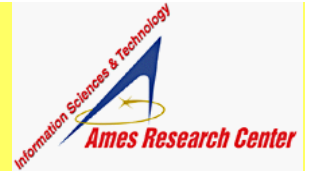
- Strong partnership with Exobiology branch and Astrobiology Institute
- Design and initial implementation of ScienceDesk tools (ScienceOrganizer, Microsensor Remote Controller, and Shared Image Annotator)
- Initiation of user testing for two of these tools

FY'00 Goals:

- Integration of three tools
- Construction of Cyanobacteria Culture Collection within ScienceOrganizer:
first actual testbed for ScienceOrganizer usage
- Enable user customization and configuration facilities



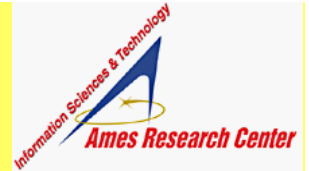
Technical Challenges & Opportunities



- Automated knowledge capture: ease user burden
- Customization facilities: content and organization
- Balance between structure and flexibility
- Novel input modes (speech, pen)
- Mobil/wireless settings
- Agent-based experiment monitoring



Characterizing ScienceOrganizer



Related tools:

- Document-sharing systems: Postdoc, BSCW, DocuShare
- Electronic notebooks
- Laboratory information mgmt. systems (LIMS)
- Personal information mgmt. systems (PIMS): MS Outlook, Palm Organizer

Distinguishing features:

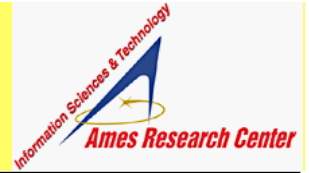
- Structured, domain-specific information space:
facilitates access and cross-project sharing
- Configurable and customizable
- Information threading to interrelate information and facilitate navigation
- Combination document repository and database
- Intelligent model-based behavior
facilitates inference

Scientific Information Items:

- sites
- samples
- images
- proposals
- measurements
- cultures
- graphs
- consultations
- participants
- stubs



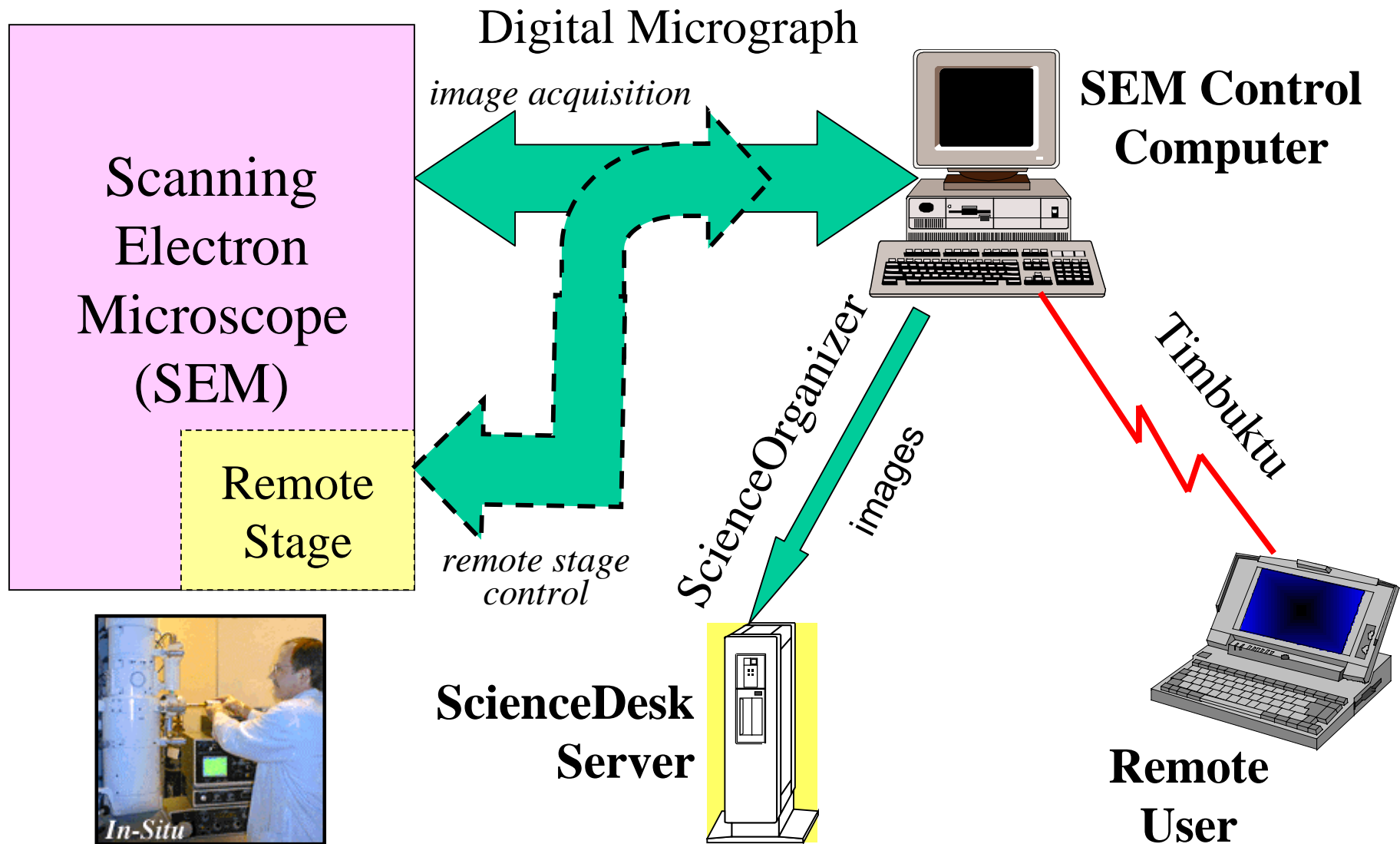
Augmentations beyond Postdoc



- **Repository contents:** includes threadable, customizable scientific records
- **User interface:** two-section display featuring items and links
- **Navigation:** users navigate via threaded links or hierarchically
- **Information modeling:** contains a semantic model of interrelationships
among different types of scientific information
- **Auxiliary tools interface:** Shared Image Annotator and Microsensor
Remote Controller

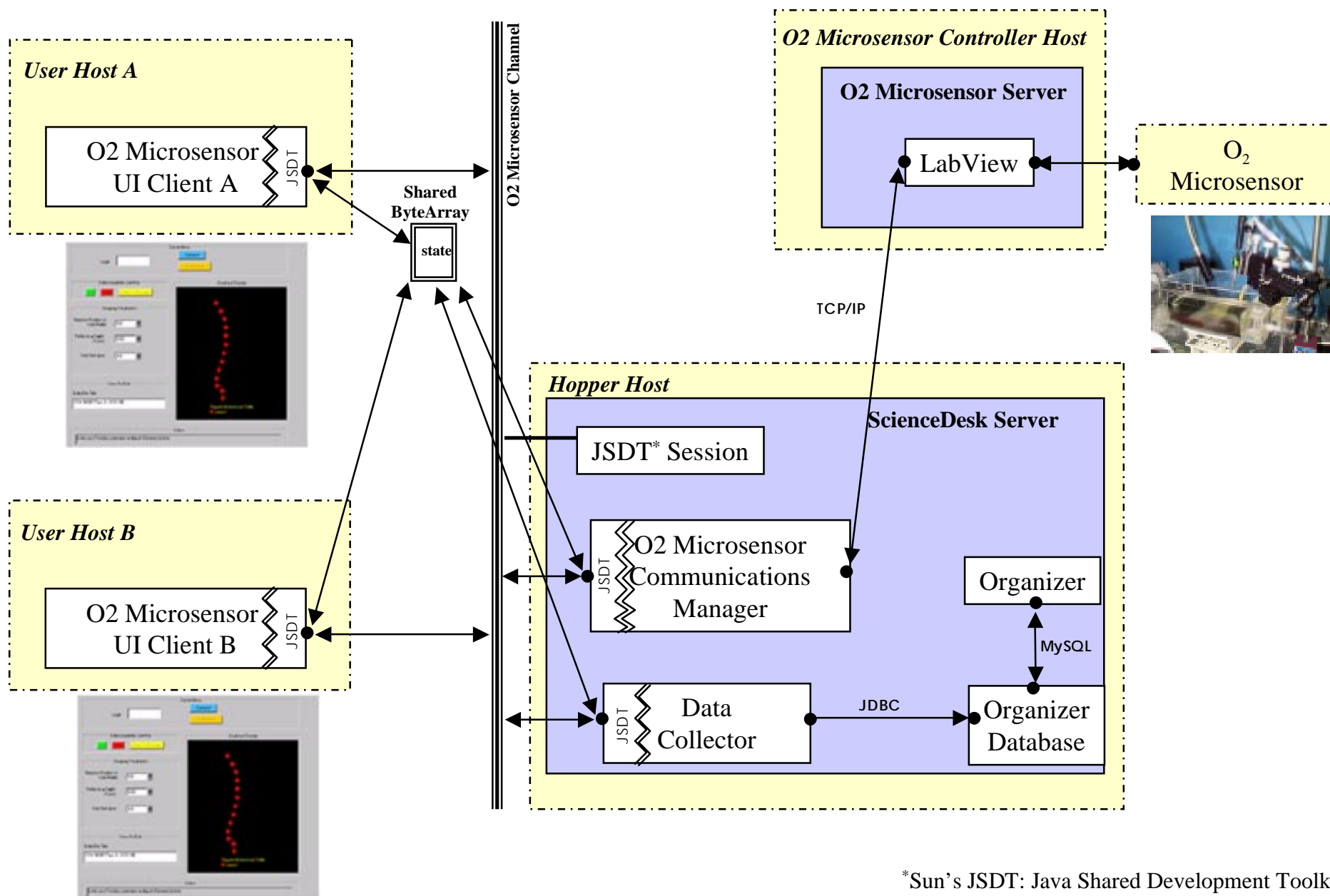


Remote Microscopy Architecture





O₂ Microsensor Control Configuration



*Sun's JSDT: Java Shared Development Toolkit